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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/648,750	08/28/2000	Chihiro Uchibori	P108077-00000	6477

7590 12/02/2003

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EXAMINER

LEE, GRANVILL D

ART UNIT	PAPER NUMBER
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2825

DATE MAILED: 12/02/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicant(s)

09/648,750

Applicant(s)

UCHIBORI, CHIHIRO

Examiner

Granvill D Lee, Jr

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 July 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 4,6,8-14,16-21 and 23-25 is/are allowed.
- 6) ☒ Claim(s) 1-2,5,7,15,22&26 is/are rejected.
- 7) ☒ Claim(s) 3 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION***Response to Amendment***

The amendment filed on 7/28/03 has been received and acknowledged to be found unpersuasive in view of the prior art of record. Further, as the claimed subject matter is drawn to device claims, the functions of the various layers do not provide a significant patentable distinction. Additionally, adhesion with respect to the layer #53, will provide improving adhesion between barrier and interconnection albeit, not directly.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-2, 7, 15 and 22, are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin (US. Pat. 6,249,055) in view of Kim et al. (US. Pat. 4,751,349).

In view of these claims, Dubin discloses a metal interconnection buried in a dielectric layer (Fig. 3 #10) having a barrier layer (Fig. 5 #52) of tantalum nitride (TaN), an interconnect layer (Fig. 54 #54) using copper (Col. 6 lines 50-55), and an aluminum adhesion layer (Fig. 5 #55).

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Dubin indicates that a copper seed layer (#56) is also used for adhesive purposes, and can be made of zirconium (Col. 7 lines 40-47). Furthermore, Dubin teaches that a nitrogen layer can form a barrier layer (Col. 7 lines 15-18), where if adjacent to a zirconium layer, would subsequently form a zirconium nitride adhesion layer. Dubin fails to make it clear that a zirconium (among others) layer could be used for an adhesion layer, calling it a seed layer (Col. 5 lines 60-67). However, Kim et al. teaches that zirconium is the main element in a multi-layer metallic structure and is used for adhesion specifically (Abstr.).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to alter the seed layer Dubin et al. teaching with that of the Kim et al. teaching with the expectation of achieving better adhesion results.

Because Dubin already teaches use of a copper seed layer, where zirconium is considered, and it was discovered by Kim et al. that superior strength is available when zirconium is used in conjunction with copper (Col. 1 line 64-col. 2 line 5), the use of Kim et al. utilizing the material zirconium merely emphasizes its adhesive use in combination of the Dubin teaching.

Furthermore, it should be pointed out that Dubin clearly uses an adhesion layer between the insulating and barrier layers, and the use of an adhesion layer between interconnection and barrier layers includes a liner/barrier layer.

Claims 5 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin in view of Kim et al. and in further view of Nogami et al. (US. Pat. 6,022,808).

Dubin discloses, as indicated, a metal interconnection buried in a dielectric layer having a barrier layer of tantalum nitride (TaN), an interconnect layer using copper, and an aluminum adhesion layer (although a liner layer is shown in-between). Dubin also teaches that the copper adhesion layer is formed on a number of different barrier layers (Col. 7 lines 15-20). Kim et al. teaches that zirconium is the main element in a multi-layer metallic structure to enhance adhesion. However, Dubin nor Kim et al. fail to suggest that a metal material having a solid solubility limit of 20% weight in copper or a resistivity increase of less than 19.8%. Nogami et al. teaches that in making an enhanced interconnection, a seed layer that is made of zirconium and when formed as an alloy should be 0.5 to 12 weight percent of copper (Col. 5 lines 10-33) and improve electro-migration resistance (Col. 5 lines 23-27). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the teachings of Dubin and Kim et al. with those of Nogami et al. with the anticipation of achieving superior electro-migration resistance, since this would lower resistance and achieve better conductivity (Col. 5 lines 13-27).

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In view of claim 26, Dubin accounts for using metal material comprised of Zr, Ag and Pb (Col. 5 lines 15-27).

Allowable Subject Matter

Claim 3 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 4, 6, 8-14, 16-21 and 23-25 allowed.

Response to the Applicant

Note that claim 6 is allowable, because the location of the interconnection copper material layer is within the opening, whereas, in claim 1 it is not.

Contact Information

Any inquiry concerning this communication or earlier communications for the examiner should be directed to Granvill Lee whose telephone number is (703) 306-5865. The examiner can be normally reached on Monday thru Thursday from 7:00 am to 5:30 pm.

If attempts to reach the examiner by telephone are not successful, the examiner's supervisor, Matthew Smith can be reached on (703) 308-1323. The fax phone number for this group is (703) 308-7722.

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Any inquiry of a general nature relating to status or otherwise should be directed to the receptionist whose telephone number is 703-308-1782.

Examiner
Granvill Lee
Art Unit 2825

GI
11/19/03



MATTHEW SMITH
SENIOR PATENT EXAMINER
ART UNIT 2825

Please note: The handling of claim 26 prevents a final rejection from being made.